edge of the slit. Rays from the aperture edges of the objective lens must traverse the entire interferometer without clipping in order to avoid vignetting effects that precipitate undesirable loss of intensity (and SNR) at the edges of the FPA. The refraction of rays in the zero-power polarizer, Wollaston prism, and cylindrical lens elements in the collimated section of the interferometer may be estimated by evoking a $\sin(u) \cong \tan(u)$ approximation. This analysis draws attention to the need for very fast collimating and imaging lenses. Alternatively, the instrument field of view (limited by the combination of objective focal length and slit length) and light gathering capability (limited by the f-ratio of the objective) may be reduced to meet the practical aperture limitations placed on the imaging lens.

This model has been formalized in concise mathematical form and prepared for publication. Ongoing work is directed at the development of model elements for two additional instrument characteristics that are very important for matching an instrument design to a particular application. These include the modeling of instrument throughput, including SNR as a function of spectral reflectance and atmospheric conditions, and the instrument lineshape. Work is also under way on a ray-tracing model for generalized two-beam interferometric instruments that will enable the formulation of more advanced designs and the realization of the full potential of DASI-type instruments. William H. Smith (Department of Earth and Planetary Sciences, Washington University) collaborated in this work.

Point of Contact: S. Dunagan
(650) 604-4560
sdunagan@mail.arc.nasa.gov

Fires, Floods, and Deforestation—Disaster Management Using Remote Sensing Technology

James A. Brass, Vincent Ambrosia, Robert Higgins

Worldwide, 70 major disasters requiring international assistance occur each year. These disasters result in 133,000 deaths, 140 million homeless, and $440 billion in property damage. In the last decade, U.S. property loss has averaged $54 billion per year. Obviously, disasters are expensive to manage and they result in destruction to homes and businesses, and loss of commerce and lives.

Through NASA's Office of Earth Science Natural Hazards Program, technology is being developed and tested to support the management mitigation of natural and man-made disasters. In cooperation with the U.S. Forest Service Riverside Fire Laboratory, an aircraft system has been developed to collect visible, infrared, and thermal data for disaster characterization and monitoring. The digital data are compressed onboard the aircraft and sent to the Internet for data distribution and information extraction.

Two major efforts were completed in FY99. The U.S./Brazil Global Change and Environmental Monitoring Program was continued to characterize fire effects and deforestation on the rainforest and savanna ecosystem of northern Brazil. This effort resulted in describing the variation in fire types throughout both ecosystems; differing fire intensities and duration will result in variation in nutrient movement, greenhouse gas generation, and plant succession. In addition, the relationship between deforestation and fire occurrence was examined to determine the role of fire in deforestation activities.

Gigabytes of image data were collected over the northern part of Brazil. Preliminary results indicate a large variability between fires and within fires (often flame temperatures range between 600 degrees Centigrade (°C) and 1000°C). In addition, fire characteristics such as the duration of smoldering and flaming activity within fires were extremely variable, resulting in different trace-gas species and amounts being produced by the fires.

The second major effort in FY99 was the demonstration and operational use of remote sensing for fire management. The Airborne Infrared Disaster

Assessment System (AIRDAS) onboard the U.S. Forest Service (USFS) twin-engine Navajo was used to detect and characterize wildland fires and prescribed burns for various government agencies. The AIRDAS is a unique, four-channel line scanner that is well calibrated for measuring fire intensities and fire-line dimension. The data collected during these missions supported agency operations as well as NASA's fire research objectives. Multiple flights were made over wildfires in California to support firefighting activities and mitigation efforts. Additional flights were made for the government of Mexico, Bureau of Indian Affairs (Colorado), National Center for Atmospheric Research (Alaska), and Association of Bay Area Governments (Diablo Mountains). In all cases, the AIRDAS characterized fire-front movement, smoke production, and fire intensity for near-real-time management objectives and research applications. The results of these flights demonstrated the utility of AIRDAS for disaster management and provided fire information valuable to ecosystem and atmospheric research.

Collaborators in this research include Philip Riggan and Robert Lockwood (U.S. Forest Service), Jóao Antonio Peréira (IBAMA, Brazil), Eric Stoner (U.S. Aid for International Development—Brazil), Heliosa Miranda and Antonio Miranda (University of Brasilia, Brazil), and Thelma Krug (Brazilian Space Institute, Brazil).

Point of Contact: J. Brass
(650) 604-5235
jbrass@mail.arc.nasa.gov

Modeling Leaf and Canopy Reflectance

Lee Johnson, Christine Hlavka

Leaf/canopy model simulations and measured data were used to derive information on the form and strength of the nitrogen (N) "signal" in near-infrared (1100–2500 nanometer (nm)) spectra of fresh leaves. Simulations across multiple species indicated that in total, protein absorption decreased near-infrared reflectance and transmittance by up to 1.8% and 3.7% respectively, and all other inputs held constant. Associated changes in spectral slope were generally in the range of ±0.02% per nanometer. Spectral effects were about an order of magnitude more subtle for a smaller, though potentially ecologically significant, change in N concentration of 0.5% over measured. Nitrogen influence on spectral slope was fairly consistent across four empirical data sets as judged by wavelength dependence of N correlation. The observed and simulated data showed similar trends in sensitivity to N variation. Further, these trends were in reasonable agreement with locations of absorption by protein-related organic molecules. Improved understanding of the form and strength of the N signal under differing conditions may allow development of reasonably robust spectral measurement and analysis techniques for "direct" (based strictly upon N-related absorption features) N estimation in fresh leaves. A pragmatic approach for remote sensing might additionally consider surrogate measures such as chlorophyll concentration or canopy biophysical properties.

Collaborators in this research include Barry Ganapol (Departments of Aerospace/Mechanical Engineering and Hydrology/Water Resources, University of Arizona) and Barbara Bond (Department of Forest Science, Oregon State University).

Point of Contact: L. Johnson
(650) 604-3331
ljohnson@mail.arc.nasa.gov